PIER Research: Strawman Reference Design for DR Information Exchange

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Background

- **The electricity crisis of 2000/2001 had many contributing factors**
  - Market power (Enron, et al)
  - Aging fossil fuel plants (pollution)
  - Flaws in deregulation (AB 1890)
  - Disconnect between wholesale and retail prices
- **However, most agree that one mitigating factor was missing**

DEMAND RESPONSE

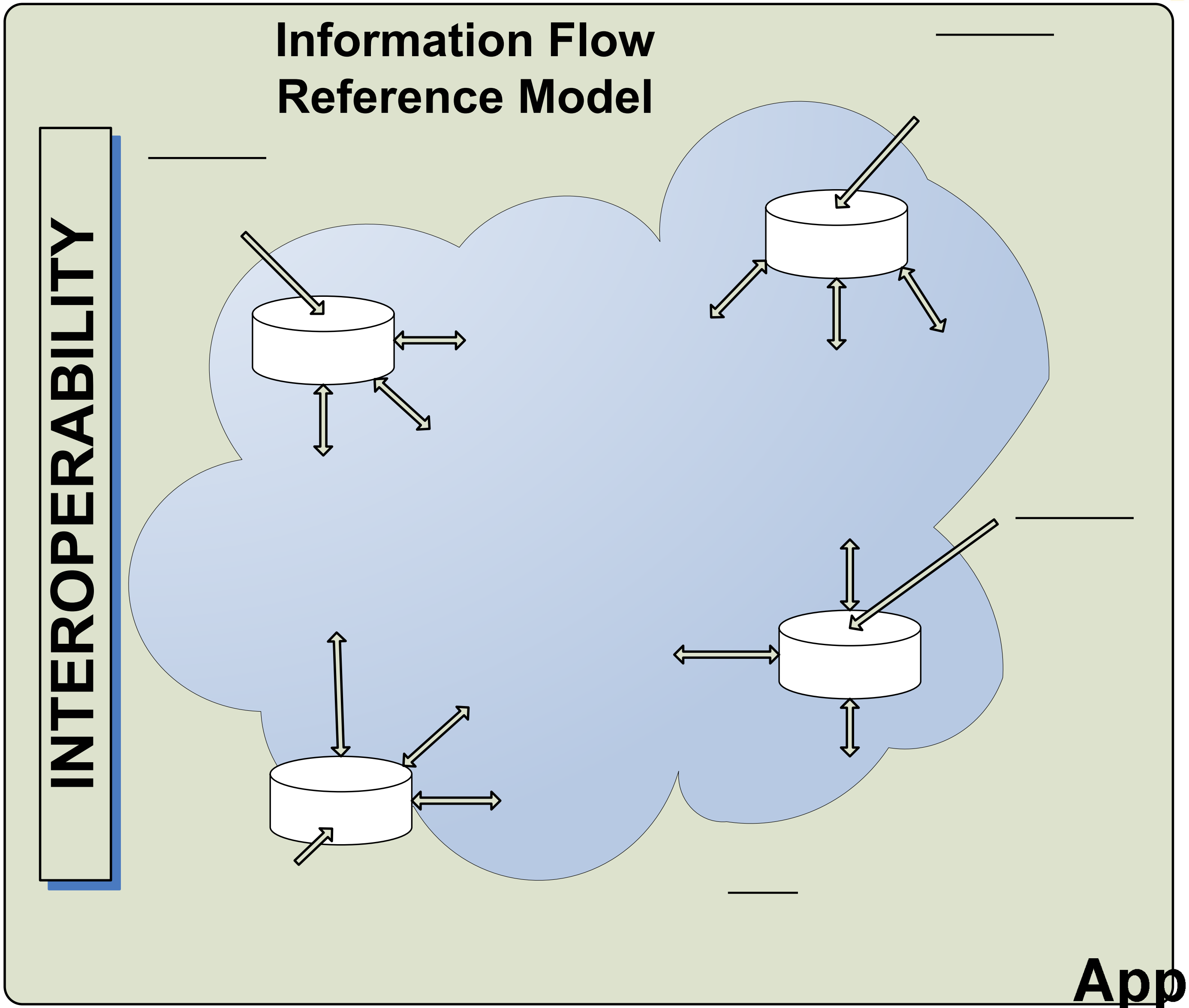
CEC Policy & Programs

- Under the leadership of Commissioner Rosenfeld, the CEC along with the CPUC, CPA, and the State's 3 major IOU's embarked upon a path to encourage DR through "price-responsive" load
- In support of this CEC policy and program, PIER initiated a DR Program to perform related R&D

Reference Design Project Genesis

- Implementing DR policy requires implementing a demand responsive infrastructure
- Stakeholders had widely varying views as to how such an infrastructure could be deployed
- Most if not all of those views were incompatible with each other, were not based on standards, were not scaleable, and would have likely resulted in more stranded assets in the long run
- The concept of a reference design as used in other industries came to mind as a way of mitigating this problem

Back of the Napkin Concept



Characteristics of Infrastructure

- **Shareability** - Common resources offer economies of scale, minimize duplicative efforts, and if appropriately organized encourage the introduction of competing innovative solutions.
- **Ubiquity** - All potential users can readily take advantage of the infrastructure and what it provides.
- **Integrity** - The infrastructure operates at such a high level of manageability and reliability that it is often noticeable only when it ceases to function effectively.
- **Ease of use** - There are logical and consistent (preferably intuitive) rules and procedures for the infrastructure's use.

Characteristics of Infrastructure

- **Cost effectiveness** - The value provided must be consistent with cost or the infrastructure simply will not be built or sustained.
- **Standards** - The basic elements of the infrastructure and the ways in which they interrelate are clearly defined and stable over time.
- **Openness** - The public infrastructure is available to all people on a nondiscriminatory basis.
- **Secure** - The infrastructure must be protected against unauthorized access, interference from normal operation, and facilitate implementing information privacy policy

Demand Response Infrastructure: Principles and Goals

- The DRI must provide a set of interfaces, transactions and services to support current and envisioned demand response functions.
- The DRI must serve all constituents.
- The DRI must promote the principles of free enterprise.
- The DRI must protect the rights of users and stakeholders.
- The DRI must promote interoperability and open standards.

Purpose of the DR Reference Design

- **To establish a common starting point for implementing open information exchange for a DR infrastructure whose characteristics include:**
  - Scalability
  - Interoperability
  - Facilitates Innovation (cheaper, better, faster)
  - Maintains Compatibility (existing and proprietary systems)
- **Guarantees regulatory bodies the ability to develop tariffs, programs and other currently unknown initiatives**
- **To protect the integrity of California's power delivery system**

Example: Emergency Load Curtailment

- **Present Day**
  - The ISO has no idea of how much ELC is available, how will or did the system respond, nor is it enough to stabilize the system
  - ISO issues command in different ways to different IOU's
  - Each IOU sends ELC signal to their subscribed loads using different methods with varying latencies and feedback
- **Future**
  - Available ELC providers known to ISO through a common information system including stats on available ELC and expected response magnitude and delay
  - ISO broadcasts ELC signal using a single, standard method to all IOU's, ESP's, LSE's, and other providers
  - Each provider relays ELC signal using standard interface to all subscribers
  - Subscriber response is confirmed, logged, and reliability statistics are updated and made available immediately to the ISO
  - Regulators are able to audit program effectiveness, system capacity and actual performance

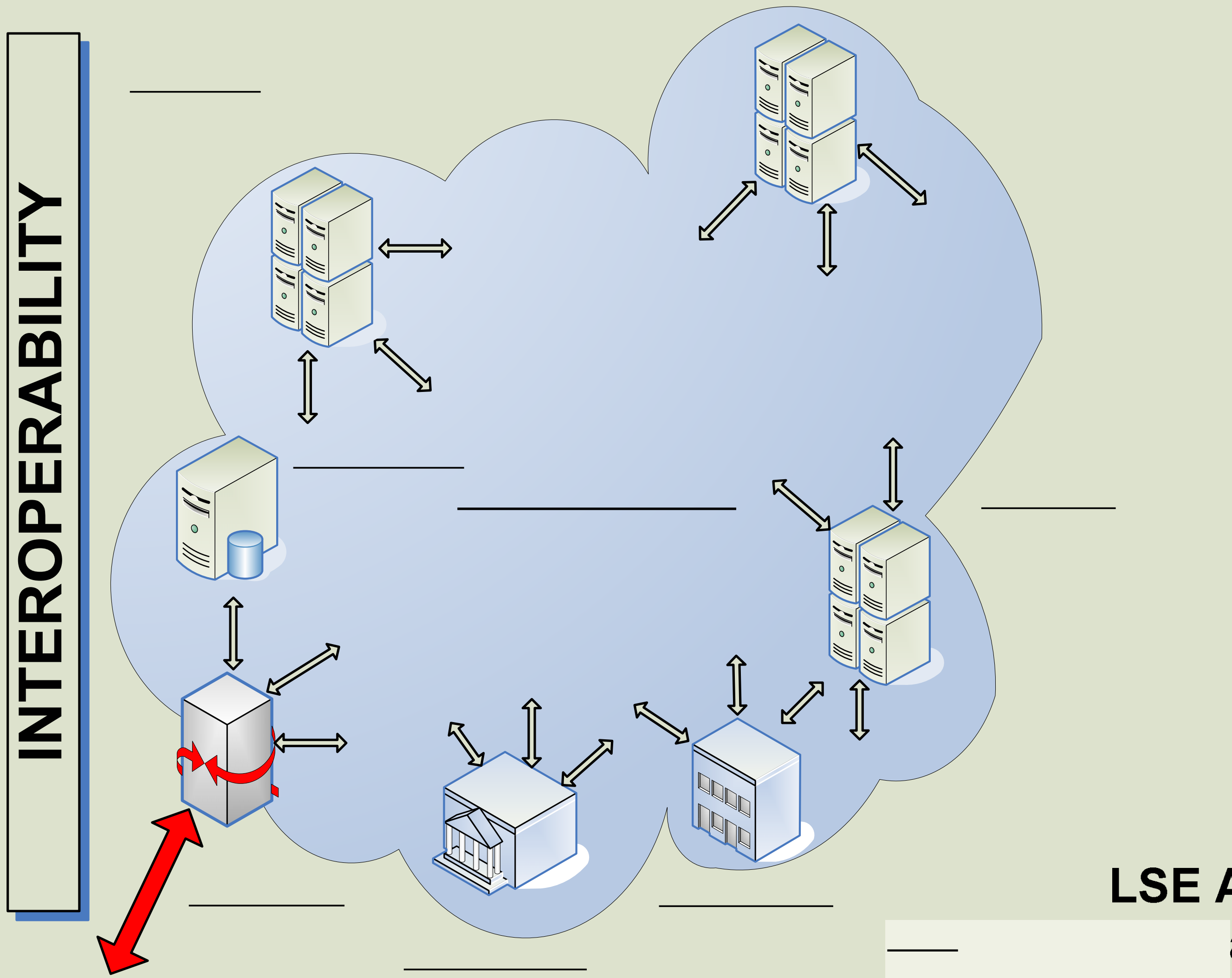
Strawman Reference Design

- **Zones of information exchange**
  - Inside is a domain of open systems information exchange
  - Outside is a domain of existing and proprietary devices and systems
- **Between the two exists a defined set of interfaces**
- **The reference design is the set of implementing standards and technologies**

Reference Design Components

- **Actors** - the entities that need to exchange information (e.g., CAISO, LSE’s, and UDC’s)
- **Applications** - the functions that need to be performed by the actors
- **Protocol** - the underlying communication methods used to move bits and bytes
- **Language** - a common language to facilitate information exchange
- **Objects** - high-level definitions of objects that are independent of protocol and language
- **Translation** - services that provide a way to allow information exchange with external systems
- **Security** - overarching methods to ensure confidentiality, integrity, and availability

Demand Response Reference Design



LSE Applications
aggregation

On-line Services

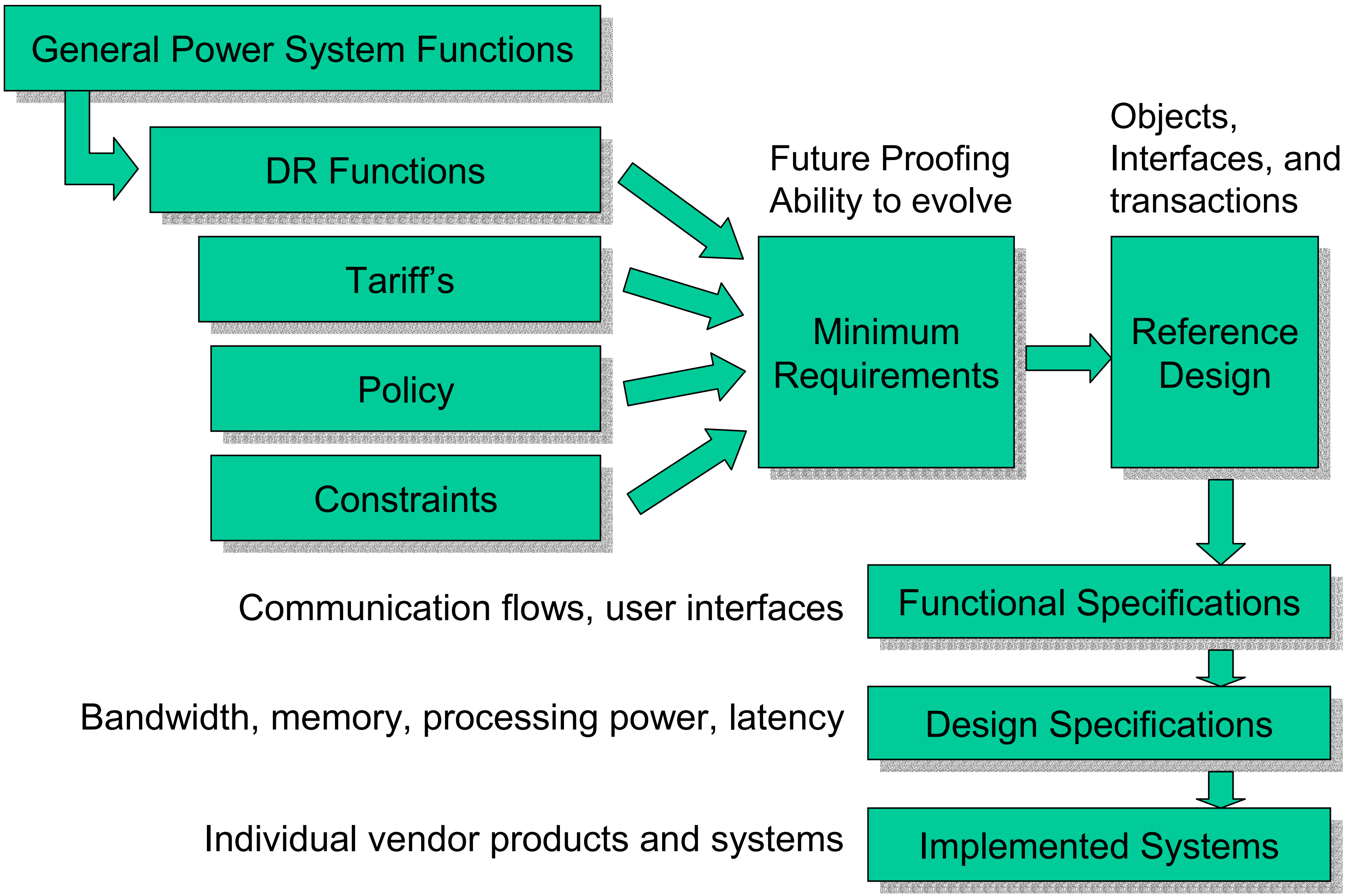
Interfaces and Transactions

- **DR information exchange infrastructure is typically specified in terms of interfaces and transactions.**
  - Interfaces constitute points of connection or interaction among system components. They often refer to places where entities may offer services or link systems; they also may refer to the links at boundaries of layers of various functions.
  - Transactions specify sets of rules and formats that determine the communication behavior between entities
- **Any new system capability will have to connect via an existing or standard interface, even if some of the properties are tailored to the specific nature of the service.**
- **It is essential that the system's key interfaces and transaction models be open to future evolution and development.**
- **It is important to specify both the underlying services and the information objects exchanged across the infrastructure.**

Creating the Reference Design

- **Map requirements to available technologies**
- **Select a subset of those technologies**
  - Protocols (how data bits are transported – e.g. TCP/IP)
  - Languages (e.g. XML)
  - Transactions (e.g. ebXML, oBIX)
  - Objects (descriptions of device attributes – e.g. ANSI C12.19)
  - Security (confidentiality, integrity, and availability)
- **Develop new instances of those technologies**
  - New device (object) models
  - DR specific transaction definitions

Mapping Process



Review – The Premise

- Demand Response (DR) will become a major resource to deal with California's future electricity problems
- An advanced metering infrastructure will be deployed on a large scale throughout the state
- Price signals will be used to induce load response when contingencies and market imbalances exist
- Technology will act as a proxy for end users

Implications

- **If the premise is true, then**
  - Information exchange will be required between several organizations and systems
  - Numerous applications that create and consume information will exist

Conclusion

For there to be seamless exchange of information in ways that we can't fully define today, there has to be a common reference design for California's demand response infrastructure

Questions ???